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Contributions to the Mesozoic flora of the Atlantic coastal plain — V.* North Carolina

EDWARD W. BERRY

(WITH PLATES 19-24)

In a brief communication by the writer published in 1907,† twenty-nine species of fossil plants were recorded from the Mid-Cretaceous deposits of North Carolina. Subsequently, *Tunion carolinianum*‡ as well as two species of *Araucaria*§ were deemed to be worthy of special description. The present paper adds twenty-nine species to this flora, bringing the total number of known forms up to sixty-one. These are all contained in the Black Creek formation and are of Mid-Cretaceous age, *i. e.*, somewhere in the lower half of the Upper Cretaceous. Continued exploration by Dr. L. W. Stephenson and the writer has increased the number of localities where Cretaceous plants have been found from four to twenty-five, all of which were unknown previous to 1907. The flora is not large and probably not more than a dozen or fifteen species will be added to it when the collections in hand are fully studied. It offers many interesting physical and biological problems which will be discussed in detail in a fully illustrated report upon this flora now in course of preparation for the North Carolina Geological Survey.

In the first contribution to this flora allusion was made to the striking absence of representatives of the class Gymnospermae, only one *Sequoia* having been recorded at that time and that one but sparingly represented. The present contribution increases the number of Gymnosperms to fifteen, which include two members of the order Cycadales and thirteen of the order Pinales. The family Taxaceae has one or more species and the remaining spe-

* Published by permission of the Director of the U. S. Geological Survey, and the North Carolina Geological Survey.

† Berry, Bull. Torrey Club **34** : 185-206. *pl.* 11-16. 1907.

‡ Berry, Amer. Jour. Sci. IV. **25** : 382-386. *f.* 1-3. 1908.

§ Berry, Bull. Torrey Club **35** : 219-260. *pl.* 11-16 + *f.* 1, 2. 1908.

cies are distributed as follows among the subfamilies of the Pinaceae: Araucarieae six species, Taxodieae four, Cupresseae one, and Abietae one. Attention was called, also, to the absence of species of *Laurus* and *Salix* in the previous collections and the prediction was made that they would probably be found eventually. This prediction is now fulfilled, four species of *Salix* and two lauraceous forms being recorded on the following pages.

CYCADALES

PODOZAMITES KNOWLTONI Berry, Bull. Torrey Club 36:

247. 1909

Podozamites angustifolius (Eichw.) Schimp. Pal. Végét. 2: 160. 1870. Not Schenk, 1868.

This species was characterized by the writer in a recent issue of the BULLETIN. The North Carolina specimens are abundant but somewhat fragmentary at the Rockfish Creek locality and what is probably the same species, but too poorly preserved for certainty, occurs at the 92 mile-post on the Neuse River.

OCCURRENCE: Rockfish Creek near Hope Mills.

CYCADINOCARPUS CIRCULARIS Newb. Fl. Amboy Clays 46.

pl. 46. f. 1-4. 1896

These supposed cycad-fruits are abundant in the Raritan formation of New Jersey and have been reported also from the Tuscaloosa formation of Alabama. They always occur as detached impressions but are well characterized and easily recognized.

OCCURRENCE: Big Bend, Black River.

PINALES

Araucaria Clarkii sp. nov.

Scale short and stout, broadly ovate, the body 12 mm. long and 9 mm. wide, not alate. Apex produced into a narrow recurved spine 3 mm. to 4 mm. in length. The enclosed seed, which is preserved in the type specimen, is obovate in outline, 4 mm. long and about 2.5 mm. wide.

This species is based upon a single specimen which is, however, clearly distinct from the large cone-scales of *Araucaria Jeffreyi* Berry, which are so common in the Black River Cretaceous out-

crops, and furnishes confirmatory evidence of the variety and abundance of the *Araucarieae* in our southern coastal plain during the first half of the Upper Cretaceous.

The present species is named for Prof. William B. Clark, geologist in charge of the coöperative investigations of the coastal plain in North Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

BRACHYPHYLLUM MACROCARPUM Newb. (?) Fl. Amboy Clays

51 (footnote). *pl.* 7. *f.* 1-7. 1896

This species was collected by the writer on July 13, 1907, but the specimens were destroyed during shipment, for which reason the occurrence is queried, although there is no doubt as to its authenticity, especially as the writer has recently collected it a short distance south of the state boundary in South Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

***Androvettia carolinensis* sp. nov.**

Remains of leafy twigs consisting of much flattened, phylloclad-like, opposite twigs, the leaves on the flat surfaces being reduced to mere points and not visible without magnification, the marginal leaves strictly opposite and represented by a regular alternation of a blunt dentate lobe and a serrate point, the leaves being fused proximally. Venation consisting of immersed vascular bundles not seen except in a strong transmitted light. Midvein strong and straight; lateral veins, which are the midveins of the coalesced leaves, pinnately arranged and single in the pointed leaves; in the rounded leaves they are usually dichotomously forked but in this case the marginal lobes may represent two coalesced leaves; their angle of divergence greater than in *Androvettia statenensis* and the whole arrangement more distinctly cyclic in character. Texture very coriaceous, the epidermal cells, however, large, though with thick walls. Stomata fairly numerous, apparently on both surfaces, and consisting of sausage-shaped guard cells surrounded by four accessory cells. (PLATE 19, FIGURES 1-6.)

The general appearance of this species is even more fern-like than in the type of the genus, one reason being its smaller size and the absence in the collected material of the supposed male aments found in connection with some specimens of the Staten Island species. The present species is confined to the Tar River exposures of the Black Creek beds and is therefore considerably younger than the Staten Island form.

This remarkable genus was erected by Hollick and Jeffrey* for the reception of a single species discovered recently in the Upper Raritan deposits near Kreischerville, Staten Island, and the writers content themselves with a very good account of this species and refrain from framing a generic diagnosis. This laudable conservatism is abundantly justified by the writer's discovery of two additional species that cannot be generically separated from the Staten Island species and furnish a number of additional characters which serve to isolate this genus.

These remains are all entirely fern-like in superficial appearance, uniformly coriaceous in texture, and by the details of their external characters and internal structure are indubitable gymnosperms of the order Pinales. Their positive reference to the Araucarineae by Hollick and Jeffrey will, however, undoubtedly be questioned by many students. The North Carolina remains are not common and are confined to a single locality on the Tar River. The lateral leaves along the edges of phylloclad-like twigs are markedly opposite, while the scale leaves on its flat surfaces are much more reduced than in *Androvettia statenensis* and cannot be made out at all except in microscopical preparations of the epidermis, in which they are seen to be reduced to mere points of termination of certain leaf-traces. The lateral twigs are strictly opposite as is the course of the vascular bundles, which consist of a regular alternation of opposite simple bundles and dichotomously forked bundles. The remains from Georgia, previously mentioned, vary from *Androvettia statenensis* in the other direction and scarcely merit the term phylloclad-like; the leaves, both marginal and surficial, are opposite and well developed, very regular, with a vascular arrangement like that of the Carolina form. They are distichous and opposite on a naked stem, which is thus more fern-like in appearance than either of the other two species. Since the anatomy of these forms has not yet been studied, the reader is referred to the memoir cited above, where the histology of the Staten Island form is discussed.

Regarding the systematic position of this genus, as already remarked, its relationship with the Araucarian group of conifers is questionable. It seems clearly distinct from *Phyllocladus* and

* Mem. N. Y. Bot. Gard. 3: 22. 1909.

it is equally distinct from the various species of *Protophyllocladus* which have been recorded from the Raritan and later Cretaceous formations of North America. It seems equally distinct from *Thinnfeldia* but may possibly prove to be related to *Moriconia*. The comparisons of *Androvettia statenensis* with the Lower Cretaceous species *Ctenopteris insignis*, *Zamiopsis insignis*, *Thinnfeldia marylandicum* and *Plantaginopsis marylandica* are singularly unhappy. The writer will show in another place that the last two are monocotyledons and the others either ferns or cycads and not even remotely related to the forms under discussion.

OCCURRENCE: Three miles below Dunbars Bridge, Tar River, Edgecombe County.

DAMMARA BOREALIS Heer (?), Fl. Foss. Arct. 6²: 54.

pl. 37. f. 5. 1882

This species was collected at the same time as the *Brachyphyl-lum* referred to above and was likewise destroyed during shipment and is consequently queried; although there can be little doubt but that the specimens were of this species, which is so abundant at homotaxial horizons to the northward. It has also been discovered recently by the writer to the southward of North Carolina in the Tuscaloosa formation of Alabama.

OCCURRENCE: Court House Bluff, Cape Fear River.

SEQUOIA REICHENBACHI (Gein.) Heer, Fl. Foss. Arct. 1: 83.

pl. 43. f. 1d, 21, 5a. 1868

Characteristic twigs of this widespread Mesozoic conifer occur at a number of localities in North Carolina. They are indistinguishable from the similar remains so common at a large number of localities in the Atlantic coastal plain.

OCCURRENCE: Rockfish Creek near Hope Mills; Parker Landing, Tar River; 92 mile-post, Neuse River.

SEQUOIA MINOR Velen. Sitz. K. Böhm. Gesell. 1886: 638.

f. 11-13. 1887

This species, which was described by Velenovsky from the Cenomanian of Bohemia and based on cone-bearing twigs, is new to the American flora unless possibly the specimen from the New

Jersey Raritan which Newberry identified as *Thuites Meriani* Heer is to be correlated with it.

OCCURRENCE: Big Bend, Black River; Parker Landing, Tar River.

CUNNINGHAMITES ELEGANS (Corda) Endl. Synop. Conif. 305. 1847.

— Newb. Fl. Amboy Clays 48. *pl.* 5. *f.* 1-7. 1896

This handsome species characterizes the Cenomanian and Senonian floras of Europe and the Magothy formation of eastern North America. Although Newberry is cited above, this species does not occur in the Raritan formation, his specimens having almost certainly come from the overlying Magothy formation.

As may be seen from the figures (PLATE 20, FIGURES 1-4), the North Carolina material is abundant and shows the characteristic leaf-scars of this species. The North Carolina forms are much more robust than any other specimens known to the writer, some of the leaves being 6.5 cm. in length and 4 mm. in width, so that it may be desirable eventually to consider them as representing a variety. However, as the usual size occurs sparingly in association with the larger examples it seems probable that both were borne by the same trees.

OCCURRENCE: Corbits Bridge, Horrell Landing, Sykes Landing, A. C. L. Bridge, Black River.

MORICONIA AMERICANA Berry, Bull. Torrey Club 37: 20.

1910

This Upper Cretaceous conifer is confined to the Bladen and homataxial horizons of the Atlantic coastal plain with a recorded range from New Jersey to South Carolina. The geometrical impressions of its symmetrical leafy twigs with their semicircular appressed leaves is so characteristic that the merest fragment is readily identifiable, even by a novice. (PLATE 20, FIGURE 5.)

OCCURRENCE: Elizabethtown, Cape Fear River.

Cephalotaxospermum gen. nov.

Fruits solitary (?), sessile or with an extremely short and stout peduncle, ovoid, somewhat pointed apically and inclined to become slightly cordate below, consisting of an outer fleshy layer and an inner bony layer, as in the Cycadales and Ginkgoales; its

surface mammillated much as in *Podocarpus elongata* but less markedly so. Bony endocarp ovate-acuminate, immersed in the apical part of the exocarp. Evidently the drupaceous fruits of some Cretaceous member of the Taxaceae which finds its closest homology in the recent flora in the fruits of *Cephalotaxus* and certain species of *Podocarpus*.

***Cephalotaxospermum carolinianum* sp. nov.**

Fruit a drupe with the following dimensions as preserved in a much flattened condition: length 6 mm. to 13 mm., averaging about 10 mm.; breadth 5 mm. to 10 mm. averaging about 8 mm.; thickness about 3 mm.; fruit in life probably almost circular in cross-section. Peduncle short and stout or wanting. Stone ovate-acuminate, lying in the apical part of the fleshy exocarp with the beaked micropylar end reaching almost or quite to the apex. As preserved in a much flattened condition in the clays, these fruits tend to split into two parts, disclosing the bony endocarp or merely a cast of its cavity. The fleshy part of the fruit is carbonized and fails to show any histological details. There is some evidence or at least a suggestion in some specimens of the remains of a micropylar canal. Away from the pointed apex, the exocarp is 1 mm. to 2 mm. in thickness reaching a thickness of 3 mm. at the chalazal end.

These fruits are very abundant at certain localities in the Black Creek formation and they have been collected also in the extension of this formation near Florence, S. C., and in the upper part of the Tuscaloosa formation in Hale County, Alabama.

Fruits referable to the Taxaceae are extremely rare in the fossil state, as are also remains of foliage which can be referred with certainty to this family. Both *Tumion* and *Cephalotaxopsis* from the Lower Cretaceous of Maryland and Virginia are founded upon foliage which seems referable with considerable certainty to this family, and these same strata in those states abound in the foliage referred to the genus *Nageiopsis*, which seems to be closely related to *Podocarpus*, so that there is considerable reason for expecting to find Upper Cretaceous representatives of the family in this same general region. Heer* describes a leafy twig from the Patoot beds (Senonian) of Greenland with a large solitary fruit which he calls *Cephalotaxites insignis*, an identification which

* Heer, Fl. Foss. Arct. 7: 10. pl. 53. f. 12. 1883.

Solms-Laubach* seems to consider probable. Bertrand† has described carbonized seeds from the Aachenien of Tournay, Belgium, under the name of *Vesquia Tournaisii*, which he considers, because of the arrangement of the vascular bundles, as intermediate between *Tumion* and *Cephalotaxus*. It certainly seems to be not without significance that remains of this sort occur at nearly homotaxial horizons in America, Europe, and Greenland.

None of the foregoing, however, are comparable with the present forms, although certain indefinite remains described by Lesquereux as *Inolepis* sp.,‡ are remotely suggestive of them. It is not believed, however, that they are congeneric.

The modern genus *Cephalotaxus* Sieb. & Zucc., with four species, is confined to the China-Japan region, although it seems evident that it was much more widespread in former geologic times, and to it should probably be referred some of the leafy twigs included in the genus *Taxites* Brong. Fruits of three species of *Cephalotaxus*, apparently identified correctly, are described by Kinkelin§ from the upper Pliocene deposits of the Main Valley in Germany. The considerations which seem to indicate a closer relationship with *Cephalotaxus* than with *Podocarpus* are the absence of the thickened peduncle of the latter and the presence of foliage in the same beds with these seeds described by the writer as *Tumion carolinianum*|| and which is of the same type as that of *Cephalotaxus* and might with propriety have been the foliage of the tree which bore the very abundant fruits here named *Cephalotaxospermum*.

OCCURRENCE: Seventy-four and three-fourths miles above Wilmington, Sykes Landing (common), Big Bend (very common), A. C. L. Bridge (very common), Corbits Bridge, all localities on the Black River in Sampson County; Parker Landing, Tar River (?).

* Solms-Laubach, Fossil Botany 61. 1891.

† Bertrand, Bull. Soc. Bot. France 30: 293. 1883.

‡ Lesquereux, in Hayden's Ann. Rept. for 1874: 337. pl. 4. f. 8. 1876; Cret. and Tert. Fl. 33. pl. 1. f. 8. 1883.

§ Engelhardt & Kinkelin, Abh. Senckenb. Naturf. Gesell. 29³: 194. pl. 23. f. 9-13. 1908.

|| Berry, Amer. Jour. Sci. IV. 25: 382-386. f. 1-3. 1908.

PINUS RARITANENSIS Berry (?) Bull. Torrey Club 36 :
247. 1909

Leaves in fascicles of threes, undoubtedly of this species, were collected by the writer on July 13, 1907, but were destroyed during shipment so that the occurrence is queried. It is associated with amber at Martha's Vineyard, Kreischerville, Staten Island, and Morgans, N. J., and with wood of *Pityoxylon* at the two latter outcrops, so that possibly the widely disseminated amber of the North Carolina Cretaceous may owe its origin to this same species.

OCCURRENCE: Court House Bluff, Cape Fear River.

ARALES

Pistia Nordenskioldi (Heer) Berry, comb. nov.

(PLATE 21, FIGURES 1-15)

Chondrophyllum Nordenskioldi Heer, Fl. Foss. Arct. 3²: 114.
pl. 30. *f.* 4*b*; *pl.* 32. *f.* 11, 12. 1874.—Berry, Bull. Torrey
Club 34: 198. *pl.* 13. *f.* 1. 1907.

This species of Heer's, described originally from the Atane beds of Greenland, was identified by the writer in 1907 among the scanty materials collected at Blackmans Bluff on the upper Neuse River in 1906 but its true botanical affinity was not determined. With the discovery of additional localities during the summers of 1907 and 1908 it was found to be exceedingly abundant and its true relations began to be suspected. In its size, outline, and venation it is scarcely to be distinguished from the modern *Pistia Stratiotes* L., which is certainly a variable and widely distributed, chiefly tropical, species. In this country it is found from Florida to Texas. Elsewhere it occurs in the West Indies and southward through Mexico and Central America to Paraguay and Argentina. In Africa it is found from Natal to Senegambia and Nubia, occurring also in Madagascar and the Mascarene Islands. In Asia it occurs throughout the East Indies and northward to the Philippines.

The fossil forms are more like the younger leaves of the modern plant (possibly a phylogenetic character in the latter), the later leaves tending toward a cuneate outline with a truncated apex and straighter sides.

A remarkable feature in connection with the North Carolina fossil form is that all of the figures on PLATE 21 except FIGURES 4 and 15 are made from sun prints of the actual leaves carefully washed out of the Cretaceous clays and subsequently mounted in balsam between glass. The epidermis is preserved in some instances and the stomata will be fully described in the final report. They are few and scattered and are confined to one surface and are altogether absent from the broad leaf-bases.

But few fossil forms have been referred to this genus. Hosius and von der Marck described in 1880 what they called *Pistites loriformis* from the Lower Senonian of Westphalia (Palaeont. 26 : 182. pl. 38. f. 151, 152) but this is probably cycadean, as Schenk suggested (in Zittel's Handbuch 378. 1890). Lesquereux in 1876 (Ann. Rept. U. S. Geol. and Geog. Surv. Terr. 299. 1874) named a remarkably well-preserved form from Point of Rocks, Wyoming, *Pistia corrugata*. This was fully described and illustrated in his Tertiary Flora (103. pl. 61. f. 1, 3-7, 9-11. 1883) and included leaves of various sizes and rootlets. It comes from beds belonging to the Montana formation (Senonian), which are of about the same age as the French beds from which the only other species is known. This latter, *Pistia Mazelii* was mentioned and figured from the lignites of Fuveau (Provence), France, by Saporta and Marion in their popular work, L'évolution du règne végétal, published in 1885 (Phanérogames 2 : 37. f. 114C, D) and has never been adequately described.

It is significant as showing how imperfect the geological record really is, even of the European tertiaries, that this widespread modern type ranged over at least two continents during the Upper Cretaceous and presumably had a still wider range in Cenozoic times, and yet not a single specimen has ever come to light at any of the thousands of localities where plant beds of the latter age have been exploited.

OCCURRENCE : Parker Landing, Tar River ; Blackmans Bluff, Neuse River ; A.C.L. Bridge, Big Bend, Sykes Landing, 56 $\frac{7}{8}$ miles above Wilmington, Corbits Bridge, and Horrell Landing, on the Black River.

GRAMINALES (?)

Phragmites Prattii Berry, nom. nov.

Phragmites sp. Berry, Bull. Torrey Club **34**: 190. *pl.* *II.* *f.* 5.
1907.

The present case is an admirable instance of the undesirable practice of not giving a specific name to specimens of somewhat indefinite botanical affinity which it becomes necessary to cite frequently in subsequent work and which cannot be done intelligently when there are dozens of "*Phragmites* sp." in the literature. To remedy this deficiency the above species is named in honor of the efficient state geologist of North Carolina.

OCCURRENCE: Court House Bluff, Prospect Hall, mouth of Harrisons Creek, Cape Fear River.

MYRICALES

MYRICA CLIFFWOODENSIS Berry, Bull. Torrey Club

31: 73. *pl.* 4. *f.* 1. 1904

Fruit which cannot be distinguished from that of this species, described from the Magothy formation at Cliffwood Bluff, N. J., is contained in the North Carolina collections.

OCCURRENCE: Parker Landing, Tar River.

POLYGONALES

Pisonia cretacea sp. nov.

Leaves ovate, 1.8 cm. in length by 1.3 cm. in greatest width, which is midway between the apex and the base. Apex wide and full, bluntly pointed. Base somewhat more narrowed and slightly decurrent. Petiole short and stout, about 3 or 4 mm. in length. Midrib narrowing rapidly from the base, slightly curved. Secondaries immersed. Margins entire.

This species differs from the only other Cretaceous species known, *Pisonia atavia* Velen. of Bohemia, in its relatively narrower outline, less rounded apex and longer petiole, both forms being of about the same size.

The present is the first undoubted Cretaceous species of this genus found in this country, and only one Tertiary species is known. The latter was recently collected by the writer from the upper Eocene of Georgia.

The existing species of *Pisonia* are numerous, inhabiting the tropics of both hemispheres, being largely developed in Central America and tropical South America, with several species in the West Indies and Antilles. Heimerl, in his treatment of the genus in Engler and Prantl's *Natürlichen Pflanzenfamilien*, divides it into six sections, some of which should undoubtedly be given generic rank, in fact Britton proposes to segregate the West Indian and Antillean species to form the genus *Torrubia* Vell., restricting *Pisonia* to the vines such as the type species, *Pisonia aculeata* L. However, in view of the foreign usage and what is more important, the geological considerations, which all point against following too closely systematists dealing only with the existing flora, especially when it is merely a question of the selection of a generic name among closely related modern forms, it is believed that a conservative course is most desirable in dealing with the fossil forms and the present new species is therefore referred to *Pisonia*.

Members of this genus are not rare as fossils, the oldest recorded species being based upon leaves from the Chlomeker sandstone near Leipa, Bohemia, and described by Velenovsky* as *Pisonia atavia*. These are of Upper Cretaceous, probably Cenomanian age, and if collected at a homotaxial horizon in this country would be referred to the genus *Persoonia* Swartz.† No other Cretaceous leaves have been referred to *Pisonia*, although Lesquereux‡ referred the only American species heretofore described, *Pisonia racemosa*, to the Laramie. Five species are recorded from the European Tertiary from beds ranging in age from the Ligurian to the Sarmatian. The present species is extremely close to *Pisonia eocenica* Ettings. from the lignites of Haering in the Tyrol, where it is represented by both leaves and fruit.

OCCURRENCE: Three miles below Dunbars Bridge, Tar River, Edgecombe County.

JUGLANDALES

JUGLANS ARCTICA Heer, Fl. Foss. Arct. 6²: 71. pl. 40. f. 2;
pl. 41. f. 4c; pl. 42. f. 1-3; pl. 43. f. 3. 1882

This is another widespread Upper Cretaceous species which

* Fl. Böhm. Kreideformation 4: 6. pl. 8. p. 13, 14. 1885.

† Cf. *Persoonia Lesquereuxii* Knowlton, Mon. U. S. Geol. Surv. 17: 89. pl. 20. f. 10-12. 1892.

‡ Lesquereux, Tert. Fl. 209. pl. 35. f. 4. 1878.

has been found in the Black Creek formation of North Carolina. The present occurrence is based on leaflets, while the type material from the Atane beds of Greenland included not only leaflets, but also characteristic nuts and supposed aments. The present is the most southerly known occurrence of this species.

OCCURRENCE: Court House Bluff, Cape Fear River.

SALICALES

SALIX FLEXUOSA Newb. Ann. N. Y. Lyceum 9: 21. 1868

This willow, which is very common in the Magothy formation in the northern and central coastal plain, occurs sparingly in the Black Creek formation. It is present also in South Carolina and Alabama.

OCCURRENCE: Prospect Hall, Elizabethtown, Cape Fear River; Big Bend, Black River.

SALIX NEWBERRYANA Hollick, in Newb. Fl. Amboy Clays

68. *pl. 14. f. 2-7.* 1896

This serrate-margined willow leaf is present from the bottom to the top of the Raritan formation of New Jersey, but has not heretofore been found outside of that state. It is sparingly represented in North Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

Salix eutawensis sp. nov.

Leaves lanceolate, somewhat falcate in some specimens, variable in size, from 5 cm. to 12 cm. in length and from 0.5 cm. to 2.3 cm. in greatest width, which is in the basal half of the leaf. Base lanceolate. Apex gradually narrowed to the attenuate tip. Margin entire for a short distance below, above which it is very finely dentate, even in the largest leaves collected. Petiole short and moderately stout. Midrib moderately stout, becoming thin in the apical part of the leaf, inclined to be curved or somewhat flexuous. Secondaries very fine and numerous, branching from the midrib at an acute angle and curving upward, becoming in their terminal portions approximately parallel with the margin, sending short curved tertiaries to the marginal teeth and from secondary to secondary. (PLATE 22, FIGURES I-II.)

This species is abundant at the upper Tar River localities but has not been detected at any other localities in the Black Creek

beds of North Carolina. It is common in the Eutaw formation at Broken Arrow Bend on the Chattahoochee River in Georgia, from which place the type material was collected, and the present name was given in manuscript in allusion to the horizon. The Georgia material is more fragmentary than that from North Carolina, but withstands drying out much better, the latter being preserved in a loose carbonaceous sandy clay which furnishes miserable museum specimens. The drawings of this species were made, however, before the material had dried and weathered.

This typical willow leaf is quite modern in appearance, suggesting the existing *Salix nigra* Marsh., *Salix fluviatilis* Nutt., or the Mexican *Salix Bonplandiana* H.B.K., and is entirely distinct from any Cretaceous willows hitherto described. It approaches *Salix Newberryana* Hollick somewhat in general appearance, but is much more elongate-lanceolate in outline and ranges to a much smaller size, besides showing other distinctive features. It resembles also certain European Tertiary willows, as for example *Salix denticulata*, *S. Lavateri*, and *S. varians*. The fruits figured on the plate with the leaves of this species are found associated with these leaves and are believed to belong to the same species. These fruits are found at the second locality cited below.

OCCURRENCE: Three miles and three and one-half miles below Dunbars Bridge, Tar River, Edgecombe County, North Carolina.

SALIX LESQUEREUXII Berry, Bull. Torrey Club **36**: 252. 1909
Salix proteaefolia Lesq. Am. Jour. Sci. II. **46**: 94. 1868.

This species, which was described originally from the Dakota group, occurs in the Raritan formation but is especially abundant in the Magothy formation of the more northerly coastal plane. It is sparingly represented in the North Carolina collections but is abundant in the South Carolina Cretaceous and in the Tuscaloosa formation of Alabama.

OCCURRENCE: Big Bend, Black River.

URTICALES

Ficus Stephensoni sp. nov.

Leaves variable in size, ranging from 6 to 18 cm. in length and from 2.3 to 6.4 cm. in greatest width, broadly lanceolate-ovate,

tapering equally from the middle toward both ends but more fully rounded at the base and more slender toward the tip, especially in the smaller leaves. Midrib broad. Secondaries very slender, leaving the midrib at a wide angle, which becomes as great as 90° in some of the larger specimens, very numerous, 2-4 mm. apart, parallel, almost straight to the marginal vein, which is well marked and about 1 mm. distant from the margin, with which it is parallel. Veinlets largely at right angles to the secondaries and not especially well shown. Petiole stout. (PLATE 23, FIGURES, 2, 3.)

This is an exceedingly well-marked species of *Ficus* and is very close to various modern species in form and venation characters, as is well shown by the figure of a leaf of *Ficus elastica* Roxb. which is introduced for comparison on PLATE 23. It is probable, however, that the texture of the fossil species was less coriaceous, since all of the larger leaves are considerably macerated.

It is believed that the larger forms represent the normal size of the leaves in this species and that the smaller leaves, which occur only in material from South Carolina, represent abortive leaves which fell before reaching maturity, as is so commonly the case with the modern allied species.

The species is named in recognition of the diligent and careful collecting of Dr. L. W. Stephenson, who discovered it at both Middendorf and Langley in South Carolina before the original material collected by the writer at Court House Bluff in North Carolina had been named.

Some authors refer leaves of this type to the genus *Eucalyptus*, with which genus the venation has much in common. In point of size the Carolina leaves are comparable with those of such a species as *Eucalyptus latifolia* Hollick, from Glen Cove, Long Island. The secondaries are less regular and only about half so numerous in the latter species and there seems to be little doubt of the propriety of referring the present species to the genus *Ficus*.

It is very similar to a variety of closely related Upper Cretaceous species of *Ficus* of the type of the existing *Ficus elastica* Roxb. and its allies, commonly cultivated as ornamental shrubs and trees under the name of "rubber plants." The comparable fossil forms include *Ficus glaucoana* Lesq. (see Fl. Dak. Group 76. pl. 13. f. 1, 2. 1892), with which there is a possibility that the present species may be identical, as it is very similar in outline and vena-

tion except that the figures of the Kansas leaves (types, 478 and 532a, Mus. Comp. Zoology) do not show any marginal vein, although Lesquereux mentions one in his description. The latter species has been detected southward along the western shore of the Mississippi embayment in the Woodbine formation of Texas and is of a more coriaceous texture, with more obtuse tip and with the secondaries going off at an angle of 60° . Another very similar species is *Ficus atavina* Heer (see Fl. Foss. Arct. 3²: 108. pl. 29. f. 2b; pl. 30. f. 1-8. 1874) which ranges from the Atane and Patoot beds of western Greenland southward along the Atlantic coastal plain to Marthas Vineyard, Glen Cove, Long Island, and Cliffwood, N. J. (all probably of Magothy age).

The North Carolina leaf has full rounded basal margins (rather, straight in *F. atavina*) with less ascending secondaries, which are also twice as numerous as in *F. atavina*; the marginal vein is also closer to the margin. Another similar species, perhaps identical with the previous one, is *Ficus Peruni* Velen.* from the Cenomanian of Bohemia, which differs from the North Carolina leaf in the same respect in which *F. atavina* Heer differs. Velenovsky points out the great similarity between *F. Peruni* and *Eucalyptus Geinitzii* Heer, a similarity which is more striking in the forms which he has referred to this species of *Eucalyptus* than it is in the leaves usually so identified by other paleobotanists.

Several specimens of *Ficus* fruits were found at Court House Bluff and at Elizabethtown farther down the river, and these may possibly be from the same trees which furnished these large leaves.

OCCURRENCE: Court House Bluff, Cape Fear River.

ROSALES

Leguminosites robiniifolia sp. nov.

Sessile elliptical leaflets about 2.5 cm. in length by 1.5 cm. in greatest width, which is slightly below the middle. Apex and base obtusely rounded, the former slightly narrower than the latter. Midrib moderately stout. Secondaries obsolete.

Better material of this species, as yet undescribed, was collected in the Middendorf formation of South Carolina.

OCCURRENCE: Court House Bluff, Cape Fear River.

* Fl. Böhm. Kreidef. 3: 16 (41). pl. 4 (12). f. 1-3. 1884. Compare his fig. 2 with Berry, Bull. Torrey Club 31: pl. 3 f. 6. 1904.

Gleditsiophyllum gen. nov.

Compound leaves with more or less inequilateral, medium, or small leaflets, with camptodrome venation, identical with the leaflets of the modern species of *Gleditsia** of eastern North America and Asia.

It has seemed wiser to establish a new genus for these forms whose name will indicate their resemblance to the modern genus *Gleditsia* without too great an indication of actual botanical identity since it is possible that these Cretaceous forms may represent some allied genus of the Caesalpinoaceae with similar foliage. The modern *Gleditsia* has five or six upland species of eastern North America and Asia. The fossil species which have been described number eight and include remains of the living *Gleditsia triacanthos* from the Pleistocene of Kentucky and *Gleditsia donensis* from the interglacial deposits of the Don River Valley in Canada. The distribution of the Tertiary species includes two Oligocene records, five Miocene, and two Pliocene. Probably, also, certain forms referred to the comprehensive genus *Leguminosites* are related to the forms just mentioned.

Gleditsiophyllum triacanthoides sp. nov.

Leaflets ovate-lanceolate, medium in size, *i. e.*, intermediate between the large and the small leaflets of *Gleditsia triacanthos* L., about 3 cm. in length by 1 cm. in greatest width, which is about half way between the apex and the base. Apex and base bluntly pointed. Margin entire, as it often is in the modern species. Midrib of medium size. Secondaries numerous, parallel, delicate, branching from the midrib at an acute angle, less than 45°, camptodrome, exactly similar to the venation of the modern species cited.

The present is the first Cretaceous record of a *Gleditsia*-like form. It is perfectly distinct from any of the known Cretaceous leaves and resembles the European Tertiary forms of *Gleditsia* as well as certain Tertiary species of *Podogonium*. Leaflets with this outline and venation are liable to be confused with the leaves of the genus *Salix*, which may account for the absence of previous Cretaceous records.

OCCURRENCE: Three and one-half miles below Dunbars Bridge, Tar River, Edgecombe County, North Carolina.

* Often spelled *Gleditschia*, from the botanist J. T. Gleditsch.

PHASEOLITES FORMUS Lesq. Fl. Dakota Group 147.

pl. 55. *f.* 5, 6, 12. 1892

This common Dakota Group species is present in considerable abundance in the Tuscaloosa formation of Alabama, so that it is not surprising to find it in North Carolina, although the material from the latter state is rather incomplete.

OCCURRENCE: Court House Bluff, Cape Fear River.

SAPINDALES

CELASTROPHYLLUM UNDULATUM Newb. Fl. Amboy

Clays 102. *pl.* 38. *f.* 1-3. 1896

This large species is represented in the Black Creek formation by even larger leaves than those found in the New Jersey Raritan. It is reported also by Smith from the Tuscaloosa formation of Alabama.

OCCURRENCE: Court House Bluff, Cape Fear River.

THYMELEALES

LAUROPHYLLUM ELEGANS Hollick, Mon. U. S. Geol.

Surv. 50: 81. *pl.* 27. *f.* 1-5. 1907

Imperfect leaves of what appears to be this species, which was described in 1907 from the Cretaceous deposits of Long Island and Staten Island, occur in the Black Creek formation. It has also been recorded recently from the Magothy formation of Maryland.

OCCURRENCE: Court House Bluff, Cape Fear River.

Malapoenna horrellensis sp. nov.

Leaves ovate-lanceolate, about 8 cm. long by 2.5 cm. in greatest width, broadest at the evenly rounded or slightly acute base, narrowing gradually upward, the apex narrow and extended but obtusely pointed. Leaf substance thin but persistent, evidently coriaceous in life, since these leaves occur abundantly at a locality where all the vegetable remains except the resistant *Araucaria*, *Cunninghamites*, and *Pistia* were evidently thoroughly macerated before entombment. Secondaries 4-6 pairs, subopposite, curved upward, camptodrome, branching from the midrib at an acute angle, the lowest branching from the top of the petiole and extending upward half way to the apex or farther, giving the leaf

a triple-veined appearance (perhaps they should be termed lateral primaries, although they are much finer than the moderately stout midrib); next pair of secondaries branching at a less acute angle a considerable distance above the base, $1/3$ to $1/2$ the distance to the apex. Tertiary venation typically Lauraceous. (PLATE 24, FIGURES 1-9.)

The anomalous leaf of this species shown in FIG. 4 has a deeply retuse apex, giving it the appearance of a *Liriodendropsis*, which is belied by its association with the normal leaves and by the character of its venation and texture.

This species is markedly distinct from the species of Lauraceous leaves hitherto described in its rounded base, the only genus of this family with such a character being *Cinnamomum* and the present species being possibly liable to be confused with *C. Heeri* when only the basal part of the leaf is found. The general proportions and characters of the whole leaf, are, however, perfectly distinct.

The genus *Malapoenna* has more than one hundred existing species, chiefly of the oriental tropics, and is well represented in the fossil state from the Dakota and Magothy formations upward. It is especially well represented in the Paleocene of Europe and the Shoshone Group of America. There are two species in the Dakota Group of the west, one of which reappears in the Tuscaloosa formation at Cottondale, Ala., and the other in the Magothy formation of New Jersey.

OCCURRENCE: Horrell Landing, Corbits (Old Union) Bridge, Parker Landing, Tar River (?).

PRIMULALES

MYRSINE BOREALIS Heer, Fl. Foss. Arct. 3²: 113.

pl. 32. f. 23. 1874

This is a widespread and characteristic species of the lower part of the Upper Cretaceous, with a range extending northward to Greenland (Atane beds) and southward to Alabama (Tuscaloosa formation).

OCCURRENCE: Rockfish Creek near Hope Mills; Court House Bluff, Cape Fear River.

MYRSINE GAUDINI (Lesq.) Berry, Bull. Torrey
Club **36**: 262. 1909

A single leaf of this upper Raritan and Dakota Group species
is present in the North Carolina collections.

OCCURRENCE: Court House Bluff, Cape Fear River.

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Explanation of plates 19-24

PLATE 19.

FIGS. 1-6. *Androvettia carolinensis* Berry. Tar River.

FIGS. 1, 3, 5, natural size. FIGS. 2, 4, 6, $\times 4$.

PLATE 20.

FIGS. 1-4. *Cunninghamites elegans* (Corda) Endl. Horrell Landing.

FIG. 2. Enlarged leaf-scar ($\times 3$).

FIG. 3. Impression of same on clay ($\times 3$).

FIG. 5. *Moriconia americana* Berry. Elizabethtown.

PLATE 21.

FIGS. 1-15. *Pistia Nordenskioldi* (Heer) Berry.

FIGS. 1-3, 5-14. A. C. L. bridge, Black River.

FIG. 4. Parker Landing, Tar River.

FIG. 15. Near Blackmans Bluff, Neuse River.

PLATE 22

FIGS. 1-11. *Salix eutaenensis* Berry. Tar River.

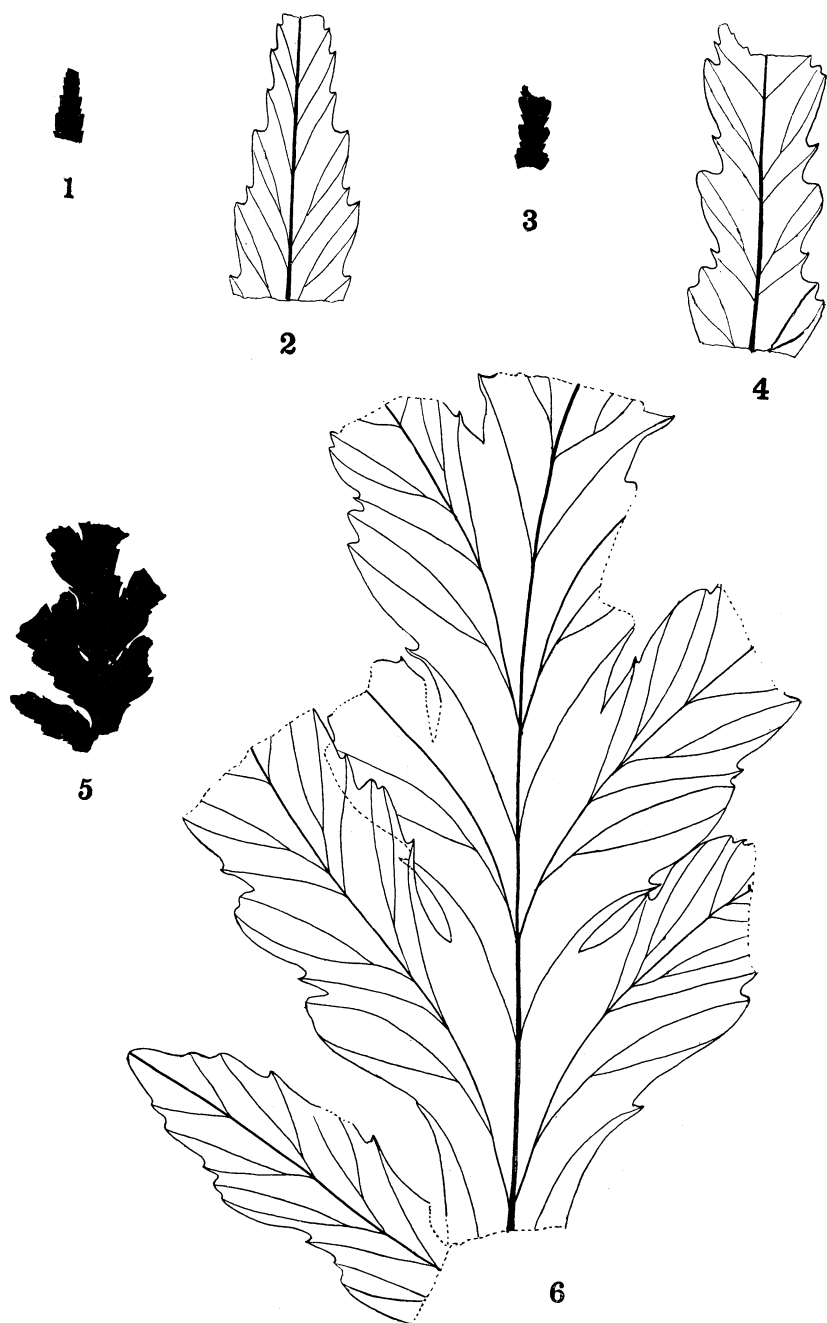
PLATE 23

FIG. 1. Young leaf of *Ficus elastica* Roxb., for comparison.

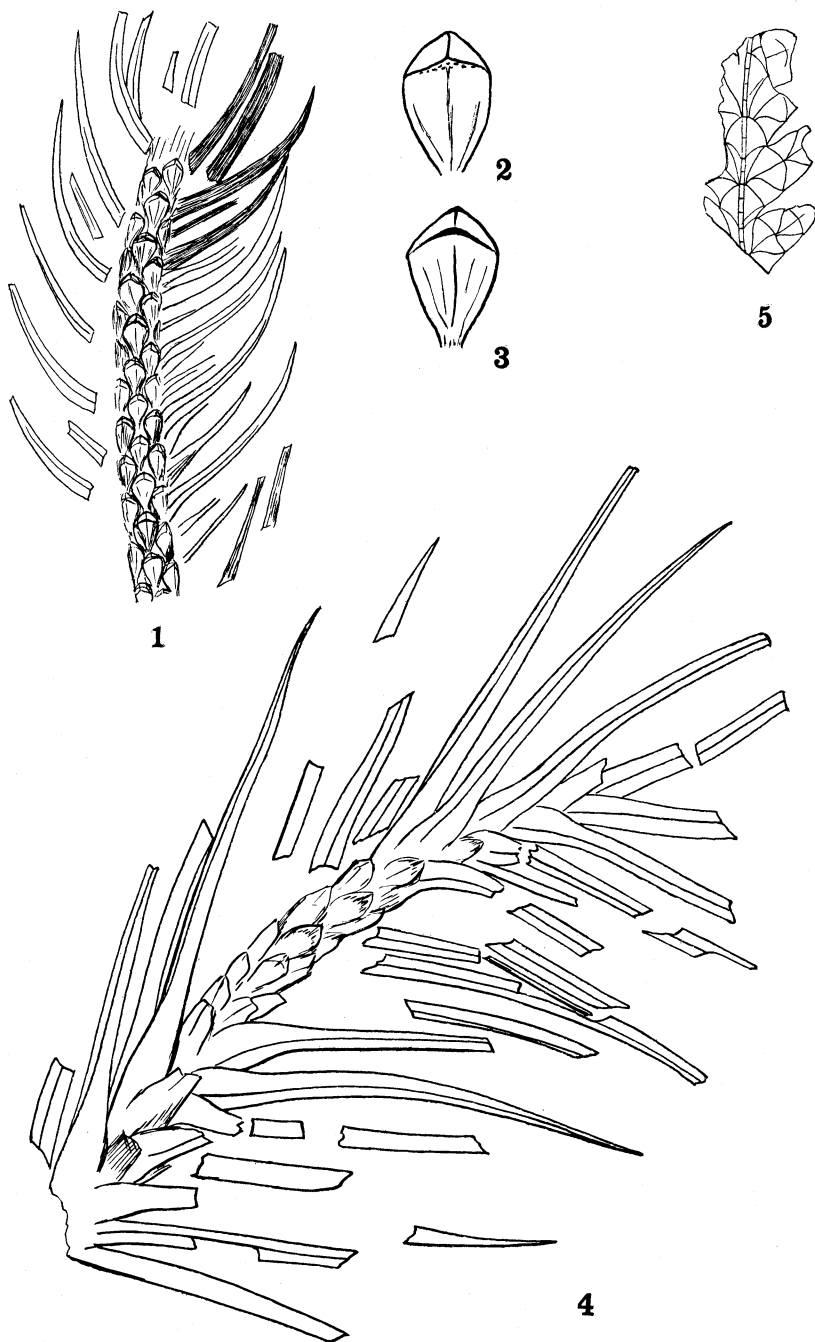
FIGS. 2, 3. *Ficus Stephensoni* Berry. Court House Bluff.

PLATE 24

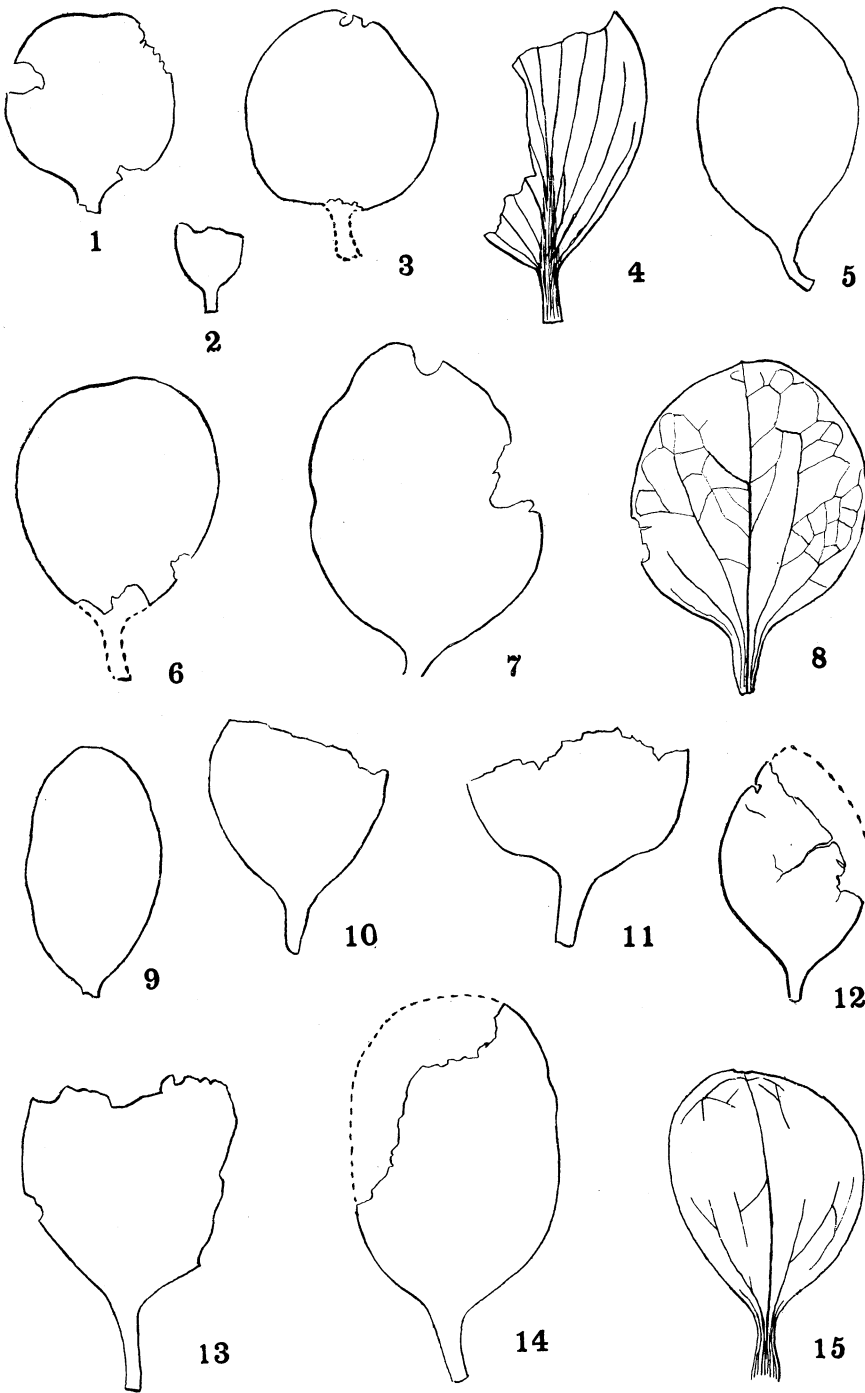
FIGS. 1-9. *Malapoenna horrellensis* Berry. Horrell Landing.



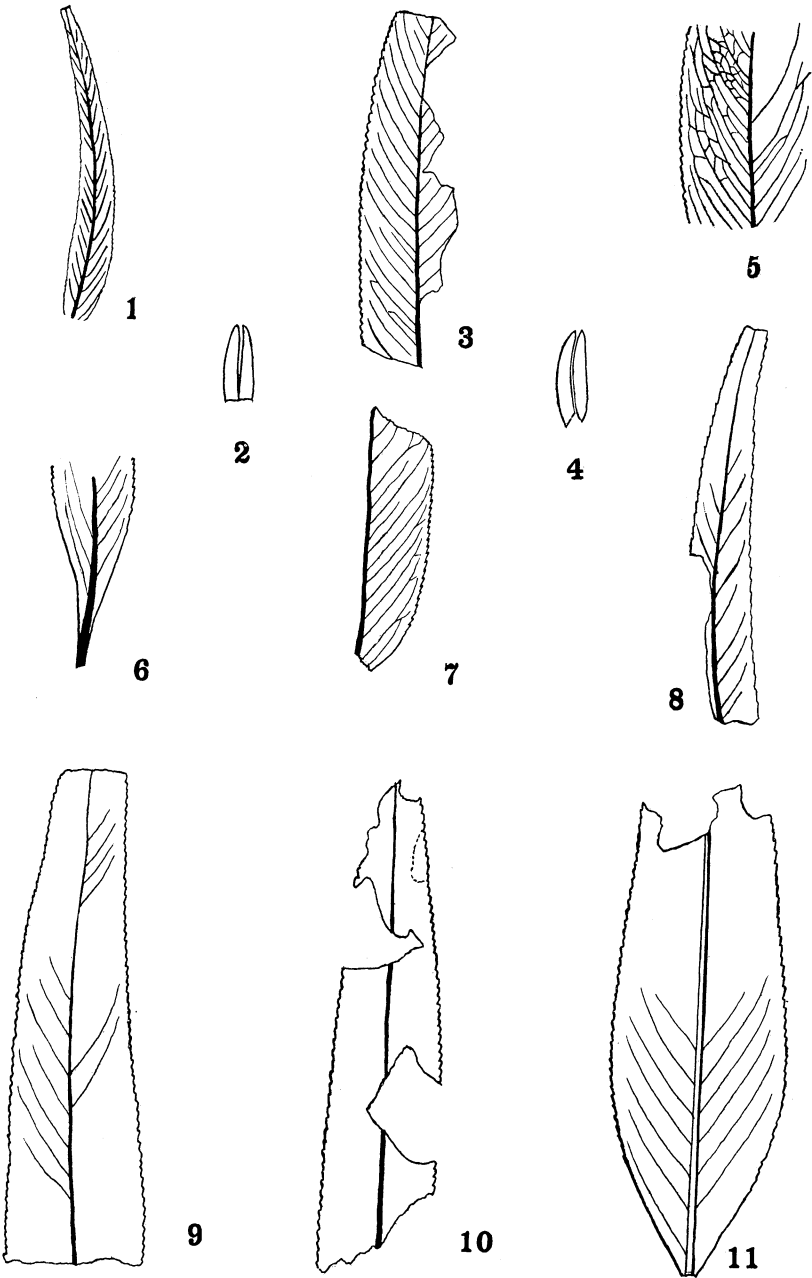
ANDROVETTIA CAROLINENSIS BERRY



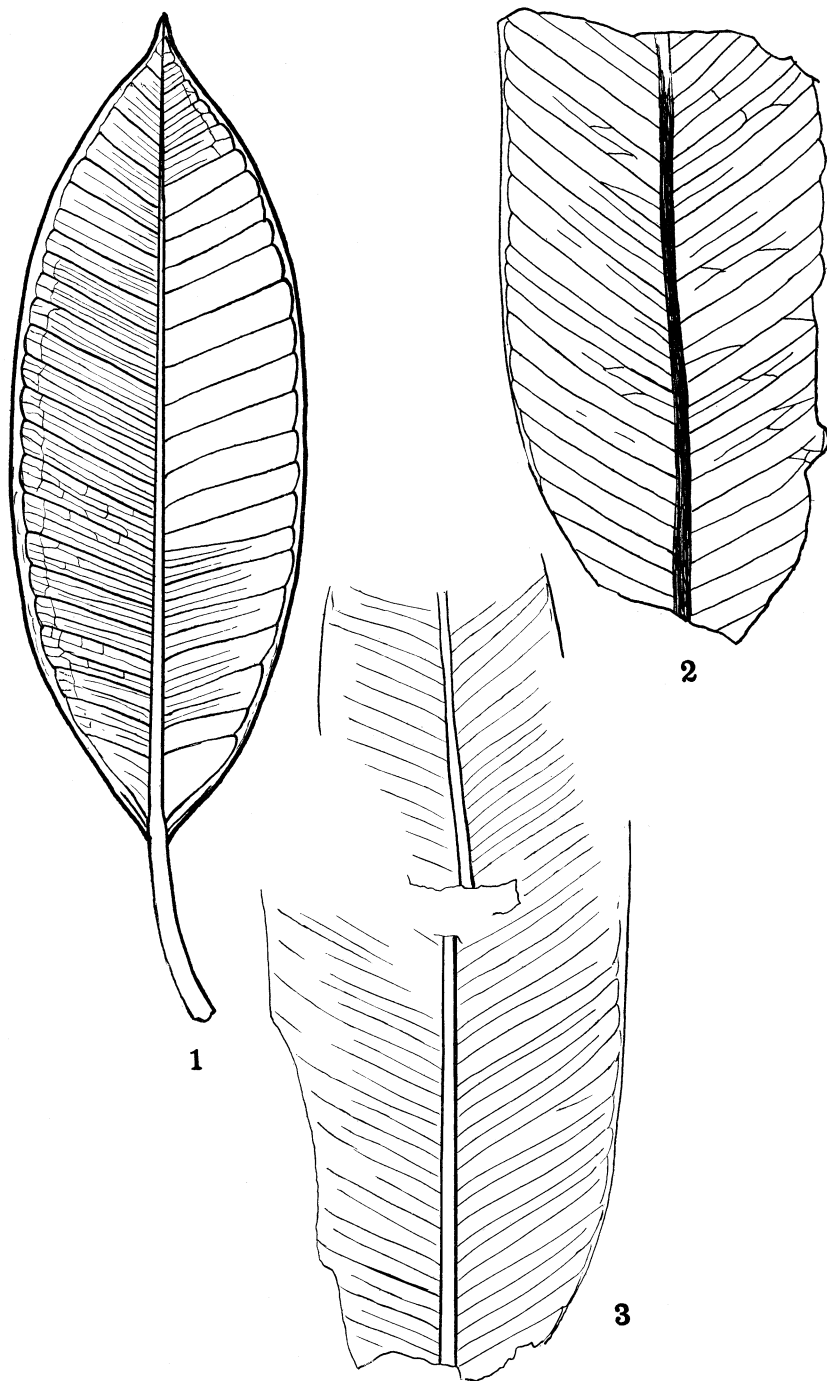
1-4. CUNNINGHAMITES ELEGANS (CORDA) ENDL.
5. MORICONIA AMERICANA BERRY



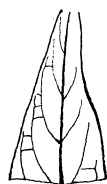
PISTIA NORDENSKIOLDI (HEER) BERRY



SALIX EUTAWENSIS BERRY



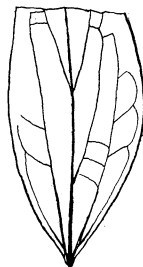
1. *FICUS ELASTICA* ROXB.
2, 3. *FICUS STEPHENSONI* BERRY



1



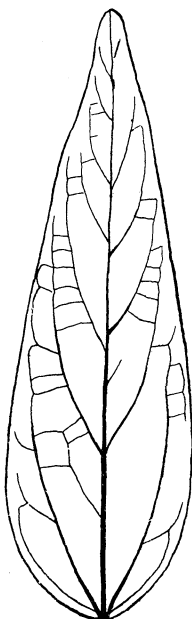
2



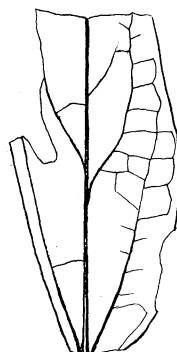
3



4



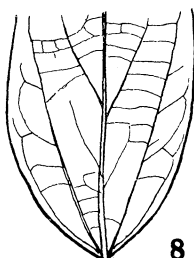
5



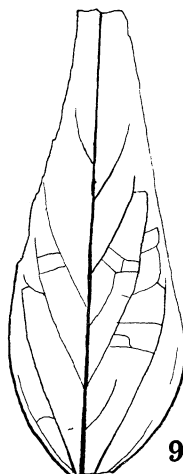
6



7



8



9